The Cause of Human Yawning

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Introduction

Although of little apparent practical significance, the reason why human beings yawn is a longstanding mystery and a topic that has been inadequately researched.

One school of thought on the matter points in the direction of an evolved mechanism to improve oxygenation. Yawning is often associated with fatigue, but no link between yawning and fatigue has been established. Establishing once and for all the true cause of yawning could lead to some modest improvement in our understanding of the inter-relationships between cardiac and respiratory autonomic function. This is relevant given that cardiac and pulmonary dysfunctions can often complicate one another and it has already been established that concussive stimulation of the heart can effect the resumption of respiration of an individual that has ceased breathing.

Abstract

Abrupt increases to heart rate lead to increases in respiratory rate. Oftentimes, accelerated respiration continues (as in the case of a person experiencing panic or in the case of a person who has recently exerted themselves physically) beyond the point where it is metabolically required and this hyperventilation can lead to over-oxygenation of tissues.

The fact that yawning entails not inhaling, but slowly and steadily exhaling (with accompanied tensing of muscles in the face and neck,) provides the first clue to its true purpose. Yawning, I posit, results from non-gradual decreases to heart rate that oftentimes occur when an individual transitions from light activity such as walking to fully idle activity such as standing or sitting still. In those cases, heart rate may go from around 100 BPM back down to around 75 BPM. Most individuals do not necessarily yawn, of course, every time their heart rate returns to 75 BPM. Likewise, when heart rate decreases in response to decreased demand, this decrease is typically gradual.

In the 70-100 BPM range, however, it is possible for these decreases to occur abruptly. Two distinct sub-regions of the brain, I would suggest, are responsible both for autonomic cardiac and respiratory function. Respiration, of course, is semi-voluntary in that we can choose to consciously override, to a certain extent, normal breathing patterns. It is already understood that the autonomic control over heart rate involves two-way communication between the heart and the brain. The heart, in response to an abrupt signal to decelerate its rhythm, as can sometimes occur when transitioning from light to zero physical exertion, could

be expected to, as a result of having an excess of chemical energy, provide a strong feedback signal meant to down-regulate respiration.

If one were to monitor the rate of decline of heart rate when an individual transitions from light to zero physical exertion under controlled conditions and were to monitor for yawning, they might find that yawns occur after abrupt decreases in heart rate from about 85 BPM to 75 BPM whereas they do not occur when the transition from 85 to 75 is tapered. The chemical and neural signaling responsible for these changes, while typically steady in the change they provoke (like a dimmer switch being turned down) can occasionally be switched entirely "off." The result is that the heart receives a signal to decelerate quite abruptly and sends a resultant counter-signal to the pulmonary system via the brain to take an action (yawning) that has the effect of temporarily pausing inhalation of oxygenated air. Most likely, an entirely different sub-region of the brain controlling autonomic function interprets the abrupt corresponding shift in counter-signal as an indication of over-oxygenation and yawns are therefore a response to perceived over-oxygenation. In most cases, these abrupt downshifts in heart rate are a result of metabolic depletion of choline compounds in the relevant region of the brain and are rarely caused by accidental over-oxygenation.

Conclusion

Understanding the inter-relationship between these two elements of autonomic function and how they are linked by yawning may serve to expand our understanding of this and other interlinked biofeedback systems in which a dynamical change to one organ system may cause unanticipated effects in another.